

Simulation Tech Tips

I-DEAS Bottoms Up Meshing Techniques

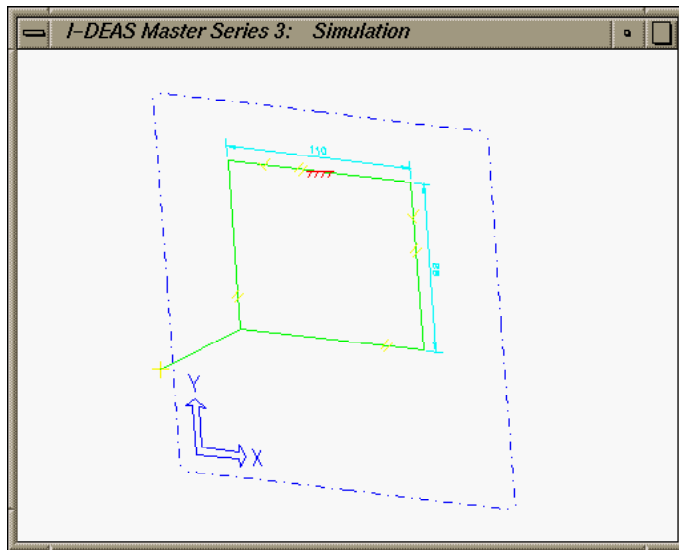


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Product Development Support

Bottoms Up Meshing Techniques

Parts on the workbench

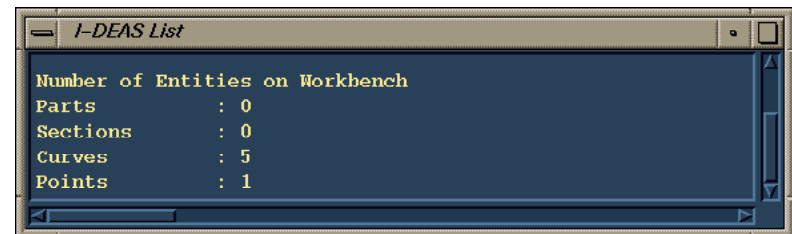
First Example... How new wireframe is handled



Use This!

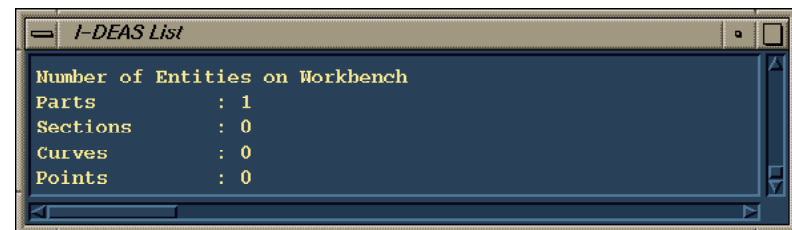


Start with new model file, add
2d sketch, add 3d wireframe
Entities on workbench are
called “Workbench_wireframe”
“/Li In Wo” gives:



Notice... no parts yet

Now give this stuff a name and
“/Li In Wo” gives:



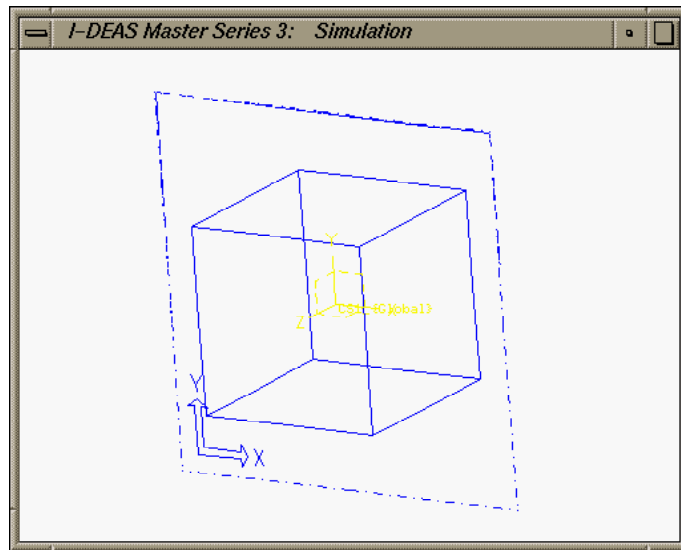
The contents of “Workbench_wireframe” are copied into the
part and a new “Workbench_wireframe” is started

/Cr Spe Attach can be used to move curves from part to
“Workbench_wireframe” and back

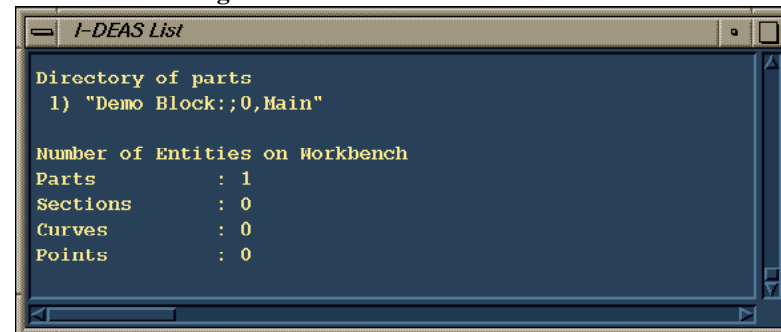
Bottoms Up Meshing Techniques

Parts on the workbench

Second Example... Null Parts



Create a block and name it,
“/L In Wo Dir” gives:



Now delete only the surfaces
Use “/Del” and filter for surfaces only

Looks like part has been deleted, but an Info on the
workbench says it is still there

Part is considered “null”, it has a name and coordinate
system and shows up on a directory, but has no geometry

Solid modeling operations can litter the workbench with null parts, you can clean them up by putting
away your good parts and then doing a “/Del” and pick all (be careful)

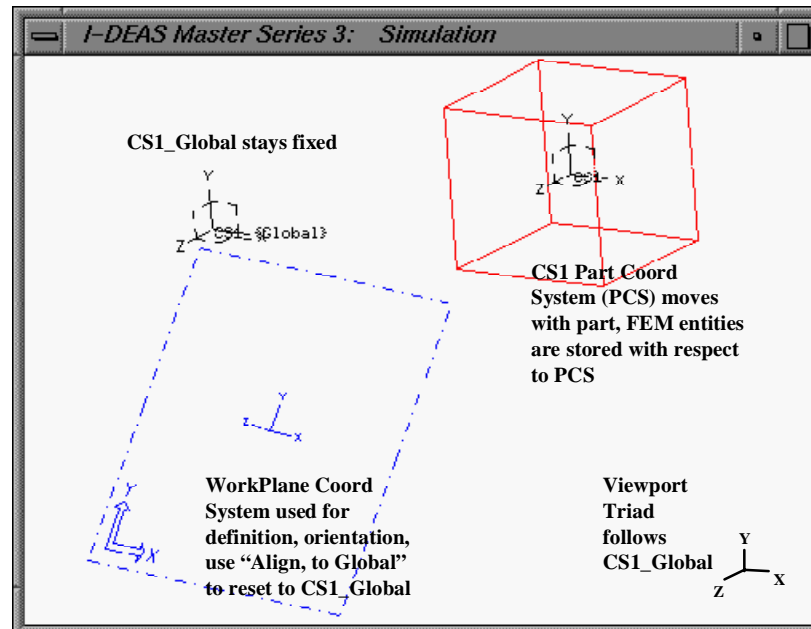
Note that the surface delete is history supported and called a minor operation
Use “/Mo Spe Mi D” to recover

Null parts can be useful (more on that in the next example)

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Coordinate systems

What coordinate system is used and how it is changed



How to align PCS with CS1_Global

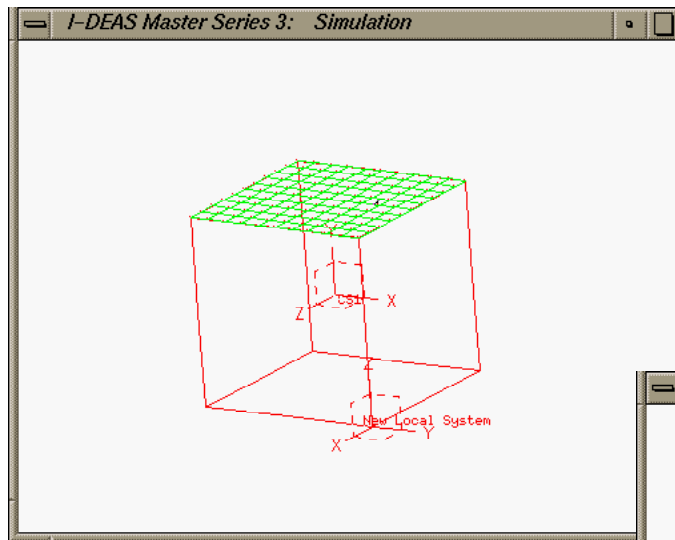
- Create null part with desired PCS
- Construct join existing part to null part (turn off relations, pick null part second)
- Existing part picks up coord system of null part
- FEM model associated with existing part is LOST!, do this procedure before meshing

Read SmartView "Simulation: Finite Element Modeling User's Guide, Simulation Techniques and Examples, Making the Part Coordinate System Coincident..."

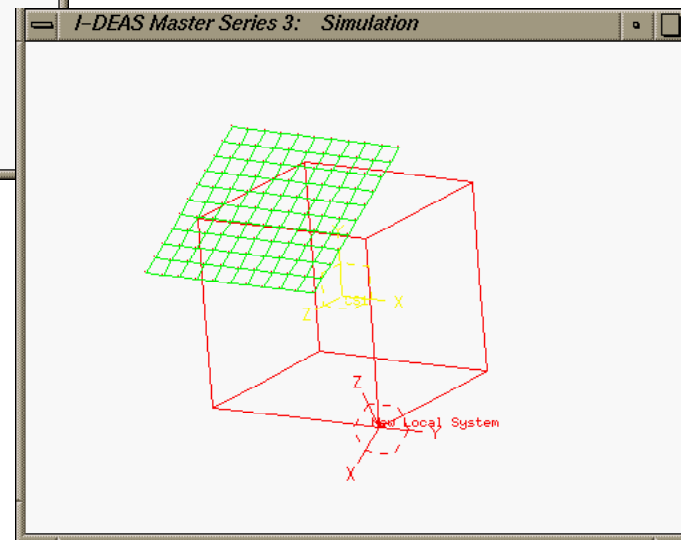
Bottoms Up Meshing Techniques

Coordinate systems

Nodes “referencing” coordinate systems can be moved by orientating c.s.



Association between mesh and surface is lost



Bottoms Up Meshing Techniques

Sketching on imported wireframe

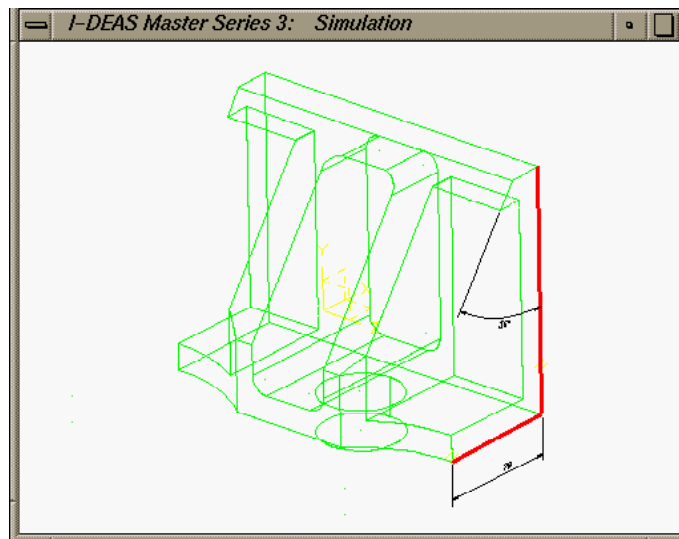
If data is precise, new solid geometry can be created

Imported wireframe is automatically put into a part, getting the navigator to recognize it can be done in two ways

First method, use /Cr Spe Attach to move curves from part to "Workbench_wireframe", then move Workplane coplanar or

Second method, build Sections directly on 3d wireframe
Sketch-In-Place will work on sections defined to be planar
Can now Extrude sections into solids or surfaces, new geometry will be created in wireframe's part (use "protrude" option not "new part")

Second method keeps geometry in one part, potentially easier to manage



Be sure to set to "Planar" before creating sections

To add additional 3d wireframe, again two ways

First method, create wireframe and attach to part using /Cr Spe Attach

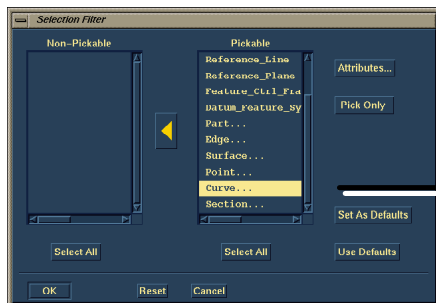
or

Second method, before creating wireframe, do a sketch-in-place on part (can pick anything, even planes on PCS triad), then create new wireframe, but now wireframe will be automatically attached to the part, not the "Workbench_wireframe"

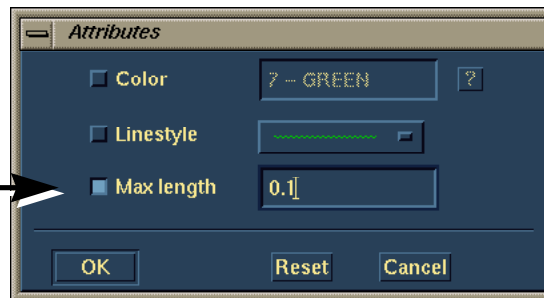
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Sketching on imported wireframe

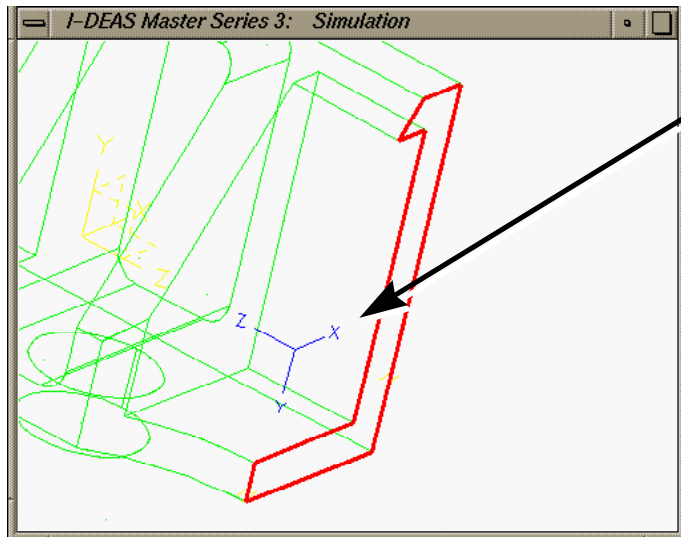
Miscellany



Filtering by entity size helps to find tiny curves



Tools to clean up wireframe are in Master Modeler



Do a Sketch-in-Place on an existing section,
Then do a /Or Mo (nothing else after)

This triad shows up

This is the origin of the active sketch plane
Why is this important?

If a beam section is created off of this wireframe, this is the
coordinate system used by the Beam Section Modeler

This origin can be changed (hold on to your hat)

- 1) Align workplane with section, put origin at desired beam section origin
- 2) Sketch-on-workplane and draw a single 2d line (make sure it has at least one constraint)
- 3) Use /Cr Spe Attach to attach 2d line to part
- 4) Sketch-in-Place and pick 2d line
- 5) Create dimension from 2d line to section (anyplace will do)
This pulls the section into the 2d line's VG network which has the new origin

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Bottoms Up Meshing Techniques

Creating and Adding new surfaces

Surface creation methods

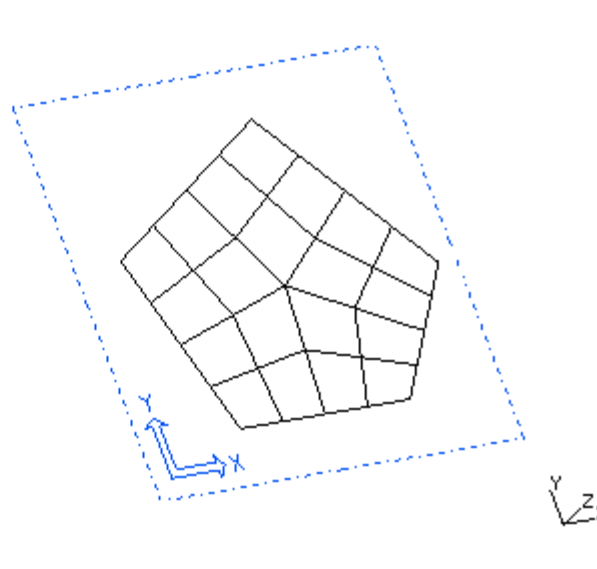
Surface By Boundary best bet, /Cr Bo

Recognizes edges, absorbs wireframe, has option to automatically stitch after surface create (under right mouse button)

Works best with 3 to 4 sides or >4 sides if wireframe is planar



If >4 sides and slightly out of plane, this happens



This is the new N-Sided Surface by Boundary, the patches remain tangent in the middle

Bottoms Up Meshing Techniques

Creating and Adding new surfaces

After creating new surfaces, what's the best way to add them to a model?



Construct Join

- Use when new surface and existing part do not share edges
- Resulting part picks up coordinate system, name, and attached FE model from second part picked (IMPORTANT!)
- If you want to join a surface into a FE model, you have to pick the surface first and the part second, otherwise the resulting part will lose the FE model
- Can be used to merge wireframe part into an existing part, or to join two wireframe parts together

Construct Add

- Doesn't have an icon, use /CO, A in Master Modeler
- Used for same purposes as Construct Join, but doesn't do surface to surface intersections, may be more reliable than Construct Join



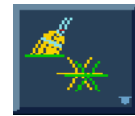
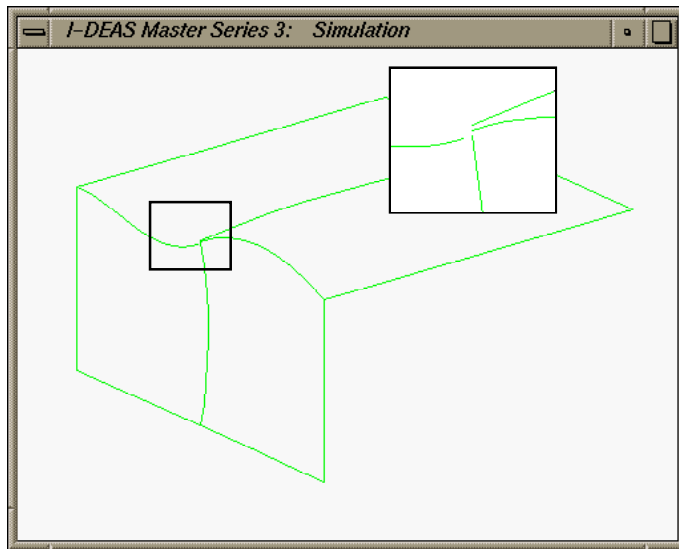
Surface Stitch

- Use when new surface shares edge with existing part
- "Newest" surface in model file is stitched into "oldest" part in model file
- If you want to stitch a surface into a FE model, the surface has to be created after the part the FE model is attached to
- For Example, you create some surfaces, you then create a part and attach a FE model to it
- You do a stitch to bring all this into one part, you then notice the resulting part has no FE model attached
- Why? Because surfaces are "older" than part being stitched to
- Workaround is easy, just copy surface part into new part, this makes it "new" as far as the stitch command is concerned
- An exception to this rule is if you use RMB "Pick Surfaces" then individually pick surfaces to stitch, in this case the resulting part picks up the coordinate system, name, and FE model of the first surface picked
- When creating a surface by boundary with the autostitch option on, this is all done automatically
- It is probably easiest to Construct, Add all the surfaces into one part, then do the stitch operation

Bottoms Up Meshing Techniques

Dealing with wireframe gaps

Real life geometry usually doesn't hold tight tolerances



“Clean points” /Mo Cl Cp can be used to merge coincident points

Coincidence zone is set by Point Coincidence Tolerance used in Master Series, normally .01 mm

If this tolerance is changed (/Mo Spe T Df) to merge curve endpoints, it **MUST** be set back to the default of .01 mm before doing more solid modeling operations

Changing the PCT can lead to unpredictable results and is not recommended



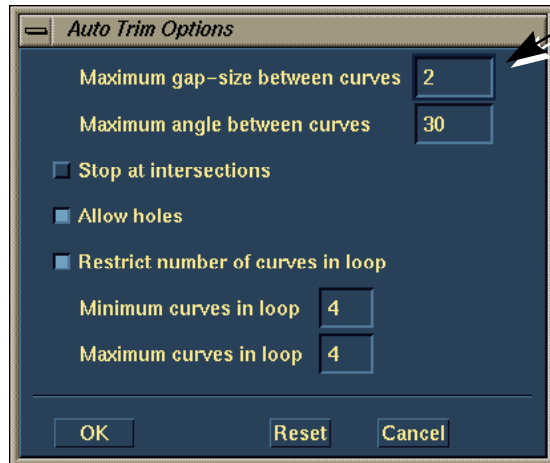
Shape Design is a useful tool for moving endpoints of splines without losing the shape of the spline

Sometimes it's just as easy to rebuild curves using 3d wireframe tools

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Dealing with wireframe gaps

Autotrim

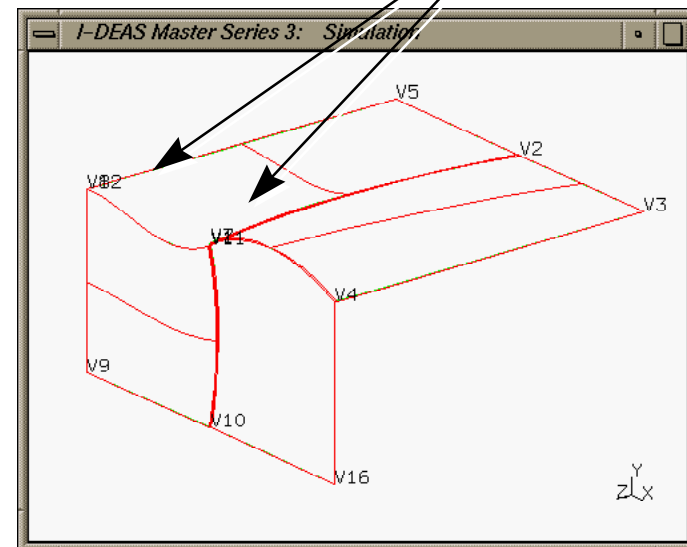


Autotrim will detect curve loops, bridge gaps, create surfaces and automatically stitch surfaces into one part

The gap filling capability should be used with caution, the gaps are filled with short curve segments which are then merged with adjacent curves

This may create discontinuities between surfaces and small edges

Turn on vertex labels to check, clumps of vertices are bad news



Bottoms Up Meshing Techniques

Warning... when mixing FE and Geometry based BCs

An operation such as a construct join, stitching, or appending to an existing fem model will trigger a mesh update of the model

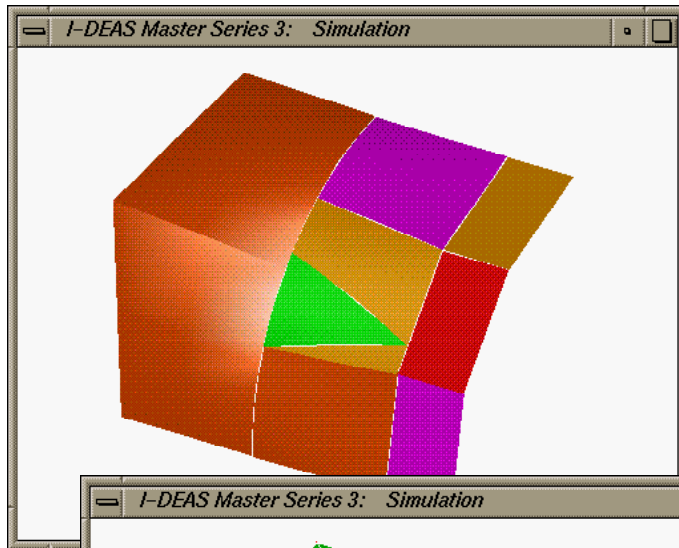
As a consequence the software will delete any pre-existing node or element based boundary conditions, if the surface topology is changed

Manually generated nodes and elements will remain, as will geometry based boundary conditions

Bottoms Up Meshing Techniques

Section meshing

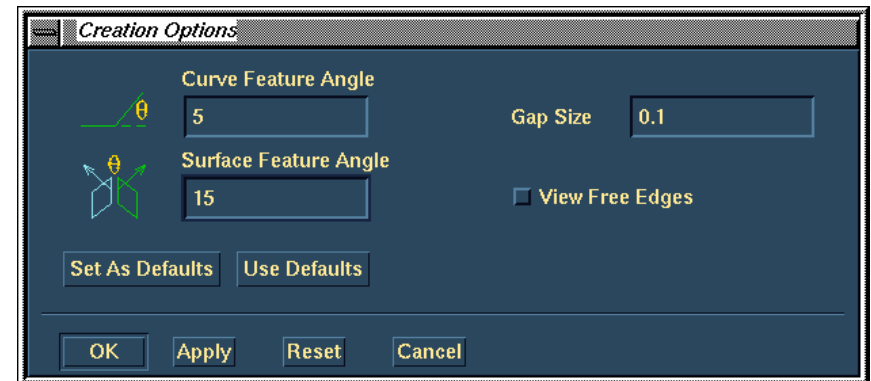
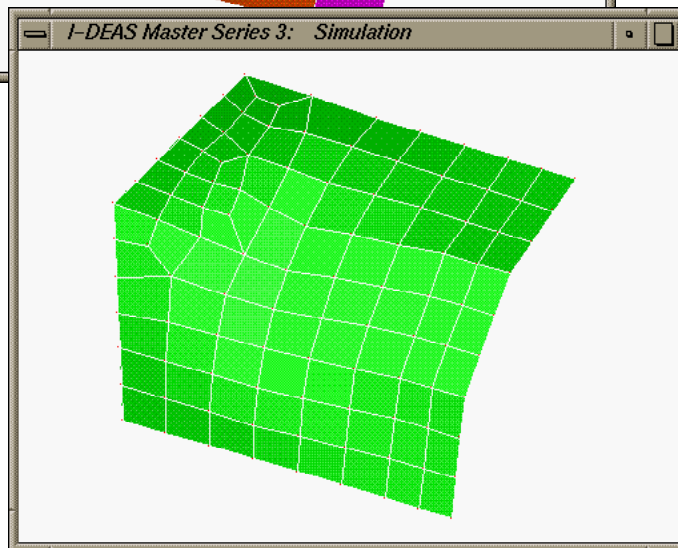
Used for creating shell meshes on gappy, awkward surfaces



Section meshing creates wireframe sections along the edges of discontinuous surfaces, this allows the mesh to span surfaces

Node locations are fixed to the section boundaries, not the surface edges, therefore alignment to surface based meshes is not guaranteed

Recommended that all sections be defined prior to meshing



Creation Options are located under the right mouse button when creating sections

These control how closely the sections follow the surface edges i.e. if two surfaces meet

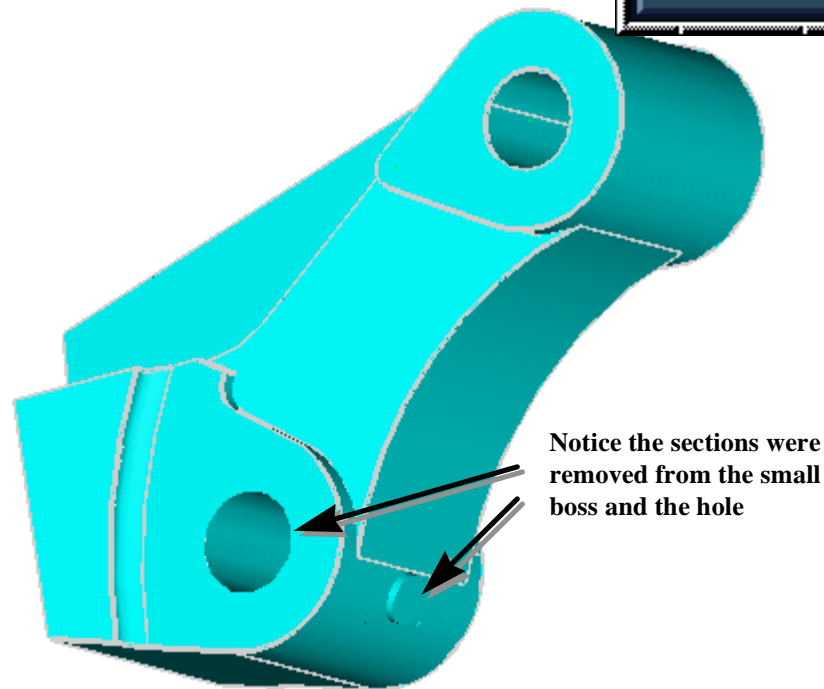
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New Section Meshing Tool

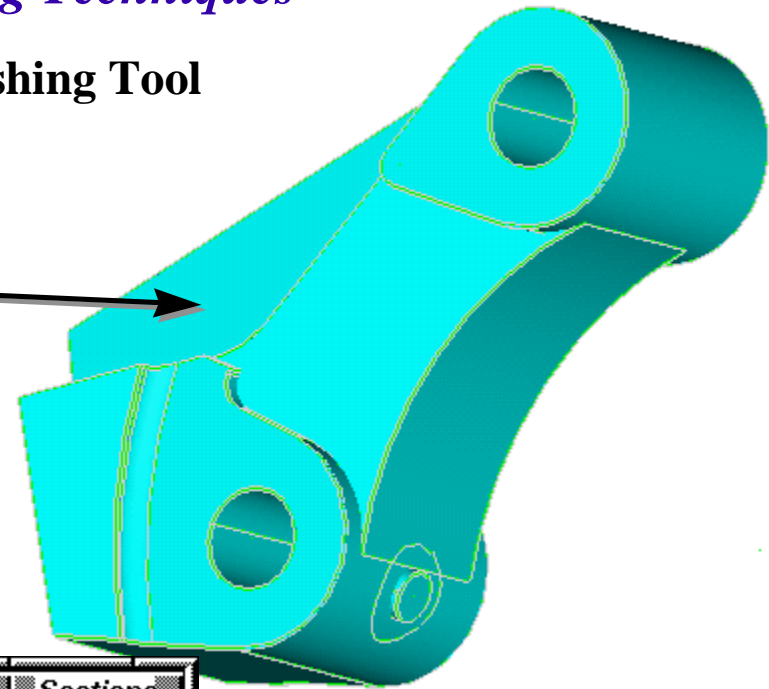
These surfaces were imported from another CAD system and are unstitched

The “Auto Create Sections” command creates sections on the surface edges

The other tools on the palette are used to redefine the sections to remove unwanted detail before meshing



Notice the sections were removed from the small boss and the hole



“Build Sections” is used to manually build sections, but is also used to merge sections together

“Divide Sections” is used to split sections, this is useful when maximum area plane meshing fails on wrapped sections

“Modify Curves” is used to remove curves from the section, such as hole definitions



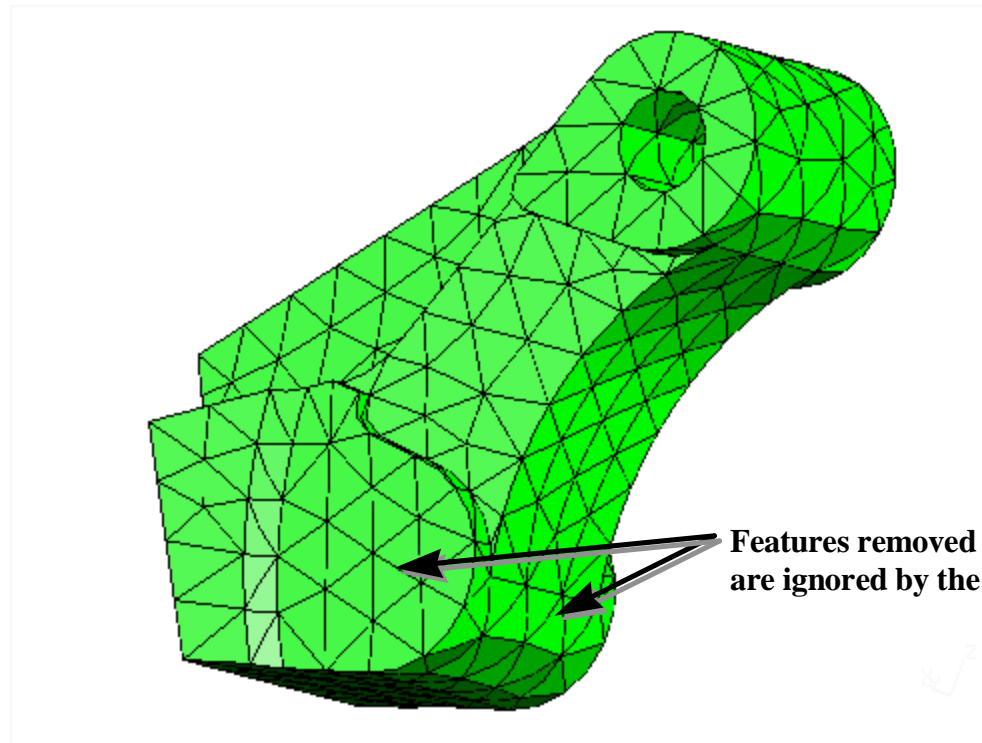
“Delete Section” deletes section and underlying curve

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/Generate, Solid Mesh From Shell



After surface coating the part with triangles, the “Solid Mesh From Shell” command can be used to fill the volume with tetrahedral elements

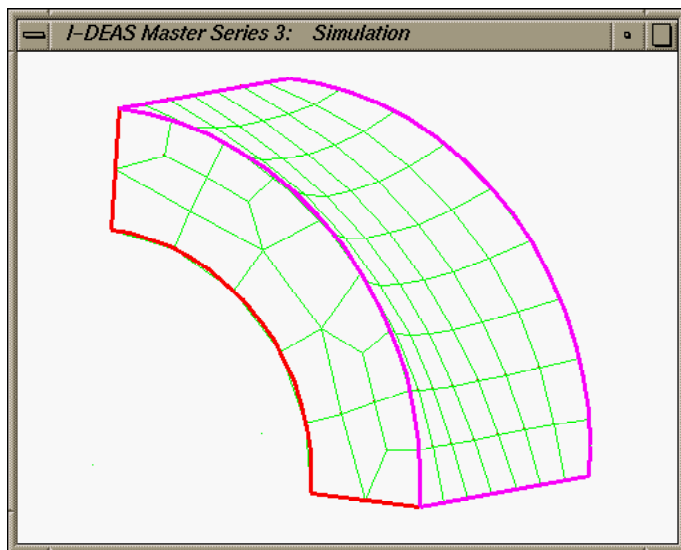
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Section meshing

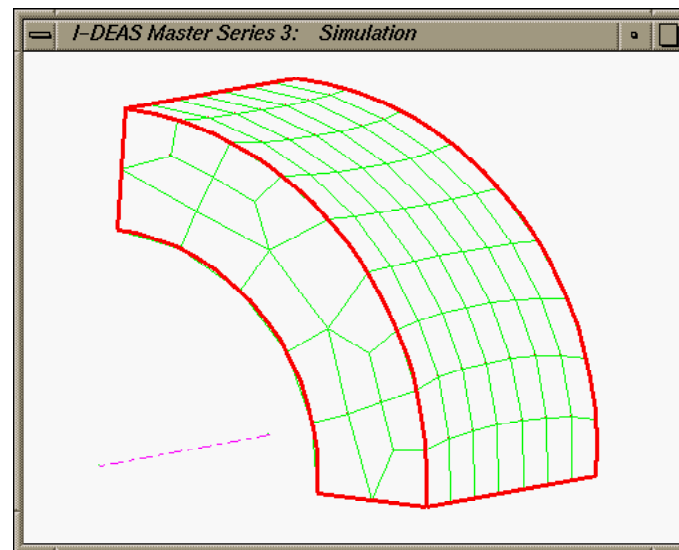
Meshing without surfaces

Section meshing works on any wireframe section

When building sections for meshing turn off the “Planar” option, this allows two sections to use the same wireframe curve and have common nodes



Mesh without surfaces, note how mesh dips between arcs



Mesh with surfaces, mesh follows surface

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Mesh between curves

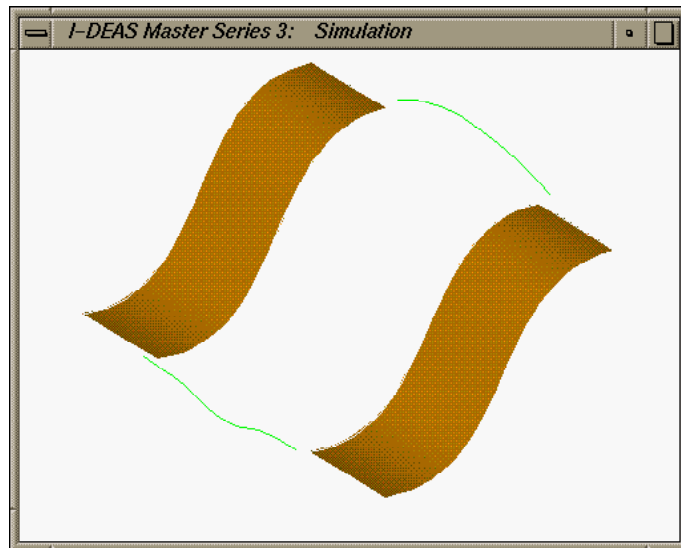
Creates a new surface and mapped mesh between curves and edges

Useful where wireframe geometry is incomplete or has gaps

Will delete the history of a part, in most cases imported geometry doesn't have history

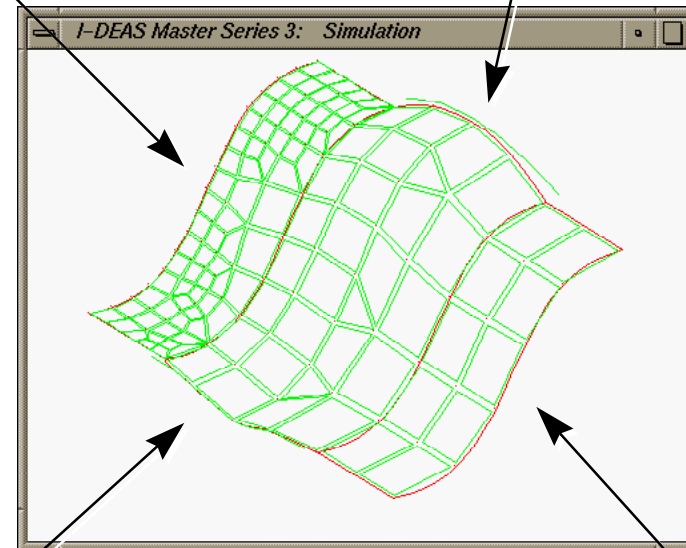
“Tweaks” curves used as rails and creates new curves

Surface edges will not be moved



Free mesh generated
on existing surface

Curve is reconnected to form edge



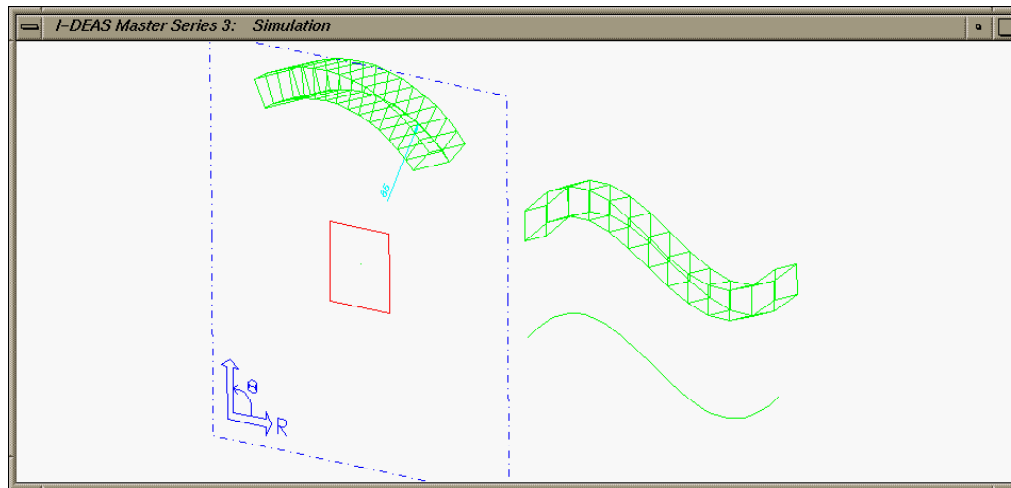
Mapped mesh generated
on new surface

Mapped mesh generated
on existing surface

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Manual Meshing Tools

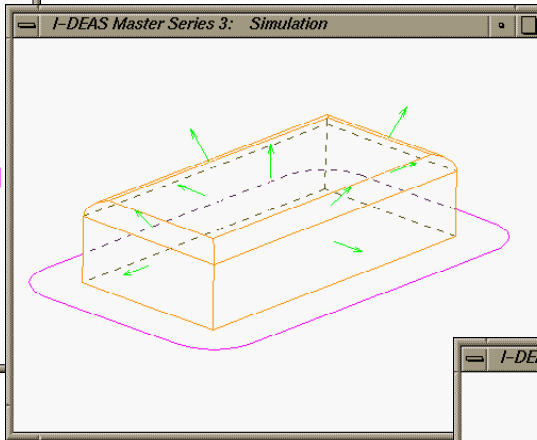
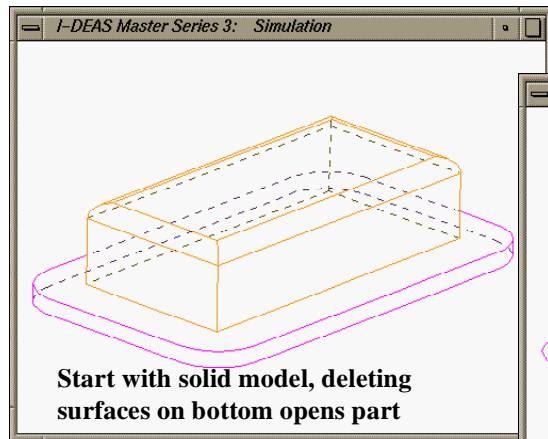
- Node Nudge
- Element Split
- Element Project
- Element Extrude
 - Uses workplane coordinate system (Cartesian, Cylindrical, Spherical)
- Element Extrude Along Path



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Open Part Modeling

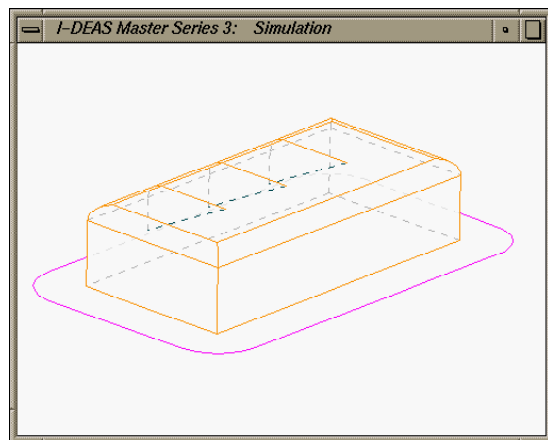
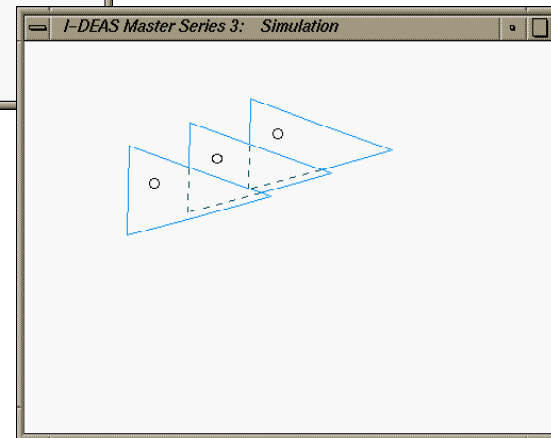
Setting Material Side allows surfaces to be used in Construct operations



Set material side on open part to "outside"



Build ribs as stand alone surfaces
Set material side to "none"



A construct join creates a single part with ribs properly trimmed (with full history)

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